GPS Data File Format
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This document describes the GPS data files created by the NOAA Aeronomy Laboratory (AL) on the New Horizon during the EPIC cruise. These files contain the information about position of the ship.

To obtain position for the AL instruments, we installed our own GPS receiver and software as part of our instrumentation. The GPS receiver is a GARMIN 35, which provides basic position and course information at one second intervals. The AL software package, ReadPACS3.exe, receives the information from the GPS receiver and processes the data in two different ways: 1. It averages the position and course information, writing the data to a file for archival. 2. It sets the time of the computer to GPS time, so that the computer clock provides a good time stamp for the data. For the EPICS cruise, both the disdrometer and the S-band radar used this clock for data time stamps. For the EPIC cruise, the position and course information were averaged for 15 seconds before writing. The clock was set to GPS time every 10 minutes.

The data was written to a text file. These files are named GPSyyddd.TXT, where yy is the last two digits of the year and ddd is the day of the year. The data below is from file GPS01260.TXT:

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1000684813 2001/09/17 00:00:13 15   10.71150  -94.85457    2.2  353.7  353.7 0 0 0 0 0 7.3
1000684828 2001/09/17 00:00:28 15   10.71182  -94.85461    2.3  354.0  354.0 0 0 0 0 0 8.0
1000684843 2001/09/17 00:00:43 15   10.71213  -94.85463    2.3  355.9  355.9 0 0 0 0 0 7.8
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There are 15 columns of data in this file, described in the table below. Each line is the data from one average period.

Column	Value shown in first line	Description
1	1000684813	Time of the end of the average period, expressed as the number of seconds elapsed since midnight (00:00:00), January 1, 1970, coordinated universal time, according to the system clock, which is GPS time.
2	2001/09/17	Date at the end of the average period, YYYY/MM/DD format.
3	00:00:13	Time at the end of the average period, hh:mm:ss format.
4	15	Period of the average in seconds.
5	10.71150	Average latitude, in degrees.
6	-94.85457	Average longitude, in degrees.
7	2.2	Average speed over ground in meters per second.
8	353.7	Average course over ground in degrees from North.
9	353.7	Average course over ground in degrees from North. For this sensor suite, heading and course are equal values.
10	0	Reserved for sensors not present for EPIC cruise.
11	0	Reserved for sensors not present for EPIC cruise.
12	0	Reserved for sensors not present for EPIC cruise.

13	0	Reserved for sensors not present for EPIC cruise.
14	0	Reserved for sensors not present for EPIC cruise.
15	7.3	Average number of satellites in view for the average period.

The graphs below show data from GPS01248.TXT. This day was selected since the data shows several points that need to be noted with this data set. This is a real-world instrument and the data is not perfect. For the most part, the data is high quality and is easy to use.

Most of the time, there are plenty of satellites clearly visible for the GPS receiver to use, as seen in the top graph. Occasionally, such as happened just after 15:00 on 5 September, the receiver is not able to lock on to enough satellites to obtain a position lock, so there are zero satellites reported. This can be caused by blockage of the signals by parts of the ship, multi-path of the signals, or poor satellite constellation geometry. During these periods of outage, the GPS receiver continues to report its last known position. The software averages these values, which for this experiment is probably okay. If the vessel were to move faster, then some other scheme, such as linear interpolation over the gaps might be required.

Other problems can be seen more easily in the plot of the longitude for this day. A good feature is the longitude is pretty smooth throughout the period of no satellites just after 15:00. For some unknown reason, there is a stray data point about 18:04, where the longitude shows a single data point that is 8 degrees off from the surrounding point. We don't know why this point is off, since all the other values for these time periods show no spikes. Another problem that occurs is shown about 23:28 on this day. The data file appears as if there were no messages for 15 seconds, so that the data fields have -999.0 values, signifying no data. This is a single record event, and does not occur very often, but it can happen.